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It ain't over till it's over: A global perspective on the Great Moderation-Great Recession interconnection

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ABSTRACT

A large-scale Factor-Augmented Vector Autoregressive (FAVAR) model of the global economy is used to investigate the determinants of the Great Moderation and the transition to the Great Recession (1986–2010). Beside the global-economy perspective, the model presents the novel feature of a broad range of included financial variables and risk factor measures. The results point to various mechanisms related to the global monetary policy stance (Great Deviation), financial institutions' risk-taking behaviour (Great Leveraging) and global imbalances (savings glut), determining aggregate fluctuations. Finally, an out-of-sample forecasting exercise provides evidence against the 'end of the Great Moderation' view, showing that the timing, though not the dimension of the Great Recession episode (2008–2010), was predictable on the basis of the same macroeconomic mechanisms at work over the two previous decades.

KEYWORDS

Great Moderation; Great Recession; Euro area sovereign debt crisis; risk factors; early warning system; macro-financial instability; Factor-Augmented Vector Autoregressive (FAVAR) models; PC-VAR estimation

JEL CLASSIFICATION

E32; E44; G15; C22

I. Introduction

A generalized dampening in macroeconomic fluctuations has been observed since the mid-1980s in the U.S. and major industrialized countries. This 'Great Moderation' phenomenon (Stock and Watson 2003, 2005) persisted for more than two decades despite various episodes of economic, financial and political distress, until the eruption of the sub-prime financial crisis in 2007, the oil price shock in 2008 and the ensuing global Great Recession. The causes of the Great Moderation have been debated in depth in the literature. One prominent view attributes the greater macroeconomic stability to 'good luck' in the form of smaller shocks hitting the economy (Stock and Watson 2003; Ahmed, Levin, and Wilson 2004; Arias, Hansen, and Ohanian 2007; Kim, Morley, and Piger 2008; Canova 2009). Other contributions focus on the role of better monetary policy in reducing aggregate volatility (Clarida, Gal, and Gertler 2000), shifting the economy away from indeterminacy and leading to an environment of price stability (Lubik and Schorfheide, 2004; Coibion and Gorodnichenko 2011). Finally, several sources of structural change, potentially responsible for declining output volatility, have been explored, such as (*i*) improved inventory management through the intensive adoption of information technology (McConnell and Pérez-Quiros, 2000; Davis and Kahn 2008); (*ii*) the expansion of the tertiary sector and contraction of energy-related and heavy industry sectors (Carvalho and Gabaix 2013); (*iii*) the decline in aggregate consumption and investment volatility due to the dominance of permanent technological shocks (Blanchard and Simon 2001); (*iv*) changes in the correlation between productivity and hours (Gal and Gambetti 2009); (*v*) lower sensitivity of aggregate expenditure to current income and interest rates due to financial innovation (Dynan, Elmendorf, and Sichel 2006).

More recently, the remarkable widening in macroeconomic fluctuations due to the onset of the Great Recession raised the issue of the end of the Great Moderation. While some contributions argue in favour of a shift to a new regime of higher macroeconomic uncertainty following the financial crisis (Barnett and Chauvet 2008; Cannarella et al., 2010; Bean 2010; Taylor 2011; Keating and Valcarcel 2012;

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Supplemental data for this article can be accessed here.

Ng and Tambalotti 2012; Ng and Wright 2013), other evidence suggests that the Great Moderation might not be over. Stock and Watson (2012) and Gadea, Gomez-Loscos and Pérez-Quiros (2014) do not detect any structural change in the volatility and in other properties of the U.S. business cycle in the aftermath of the Great Recession. Chen (2011) points to a reversion towards a low-volatility regime in the G7 countries already occurring about the end of 2009. International evidence of a purely temporary change in the GDP growth rate is also detected by Charles, Darné and Ferrara (2014). Larger oil price and financial disturbances ('bad luck') would then be at the root of the rise in macroeconomic uncertainty caused by the financial crisis, driving the transition from the Great Moderation to the Great Recession (Clark 2009). Also the most recent data, though not yet thoroughly researched, seem to suggest a return to a reduced volatility macroeconomic regime (Furman 2014).

In light of the above evidence, this article takes the perspective that the Great Moderation and Great Recession share an important global dimension and are tightly interrelated phenomena, with the purpose of getting a clear understanding of their main underlying driving forces and the features of the transition from a period of relatively subdued fluctuations to an episode of remarkably higher macroeconomic volatility.

To this aim, we employ an econometric approach with two novel features. First, rather than carrying out a country-by-country analysis, as in most previous studies, we adopt a global-economy framework. A large-scale, Factor-Augmented Vector Autoregressive (FAVAR) econometric model, covering 50 OECD and emerging economies, is used to investigate global energy, goods, labour, monetary and financial asset market conditions. In addition to providing a global perspective, the large-scale framework also grants the benefits of more accurate estimation of structural disturbances, overcoming the potential drawbacks of model misspecification and inconsistent estimation of shocks affecting small-scale VAR models (Giannone, Lenza, and Reichlin 2008). Second, we include in the model a large set of financial variables, allowing for identification of a broad range of structural disturbances related to financial markets, and a comprehensive array of risk factor indicators, meant to capture investors' expectations and sentiments about the state of the business cycle.

Our findings point to several structural supply-side, demand-side and financial shocks as the main driving forces of macro-financial fluctuations over the Great Moderation and the transition to the financial crisis and the Great Recession, related to various mechanisms already documented in the literature. For example, the early 2000s might have witnessed the setting in of a new international monetary regime based on a 'Great Deviation' (Taylor 2010, 2013; Hofmann and Bogdanova 2012), as the monetary policy stance turned (over-)accommodative in many industrialized and emerging countries, following the sequence of interest rate cuts implemented by the U.S. Fed to contrast the recessionary effects of the dot-com bubble, the ensuing jobless recovery and deflationary expectations. The narrative tells that the Great Deviation originated in the U.S., spilled over internationally through the attempt of foreign central banks to resist unwanted fluctuations in exchange rates and capital flows, by keeping interest rates low in the face of the U.S. Fed's expansionary policy. Moreover, the destabilizing effects of buoyant liquidity were amplified by excessive risk-taking of financial intermediaries, giving rise to the 'Great Leveraging' phenomenon (Taylor 2012), boosted by financial deregulation and innovation (Taylor 2010; Kahn 2010; Bernanke 2010; Dagher and Fu 2011) and misled risk perceptions (Lettau, Ludvigson, and Watcher 2008). An alternative explanation, the 'savings glut' hypothesis (Bernanke 2005), points to foreign factors, rather than Fed's policy, as the main forces driving downward the U.S. real interest rates and deteriorating the U.S. current account deficit. Financial crises in emerging (especially East Asian) countries during the 1990s led their central banks to build up foreign exchange reserves and to convey national savings to international capital markets. As the Great Deviation hypothesis, also the savings glut view highlights the fact that the transition to the Great Recession occurred in an environment of too low real interest rates, originating a sequence of asset price misalignments involving initially bonds, stocks and house prices, and then oil and non-energy commodity prices (Caballero, Farhi, and Gourinchas 2008a; Caballero and Fahri 2014). As the bust phase of the financial cycle set in, deteriorating balance sheets forced financial institutions into deleveraging and fire sales of assets, triggering a contraction in

domestic and external demand through a credit crunch and worsening expectations about future credit supply and higher precautionary savings due to mounting uncertainty about the resilience of the international financial system (Adrian and Shin 2010; Bean 2010; Bagliano and Morana 2012; Morana 2013).

Our results provide insights on the relevance of those mechanisms for the global economy in the period leading to the Great Recession. To preview, global macro-financial dynamics over the 1986–2010 period are due to a composite set of structural disturbances coming from all (supply-side, demand-side and financial) sources. Some of those shocks displayed increased volatility well before the onset of the Great Recession, which is better interpreted as the final outcome of an ongoing process, in accord with the account provided by Caballero, Farhi and Gourinchas (2008b). The savings glut, Great Deviation and Great Leveraging hypotheses are then complementary explanations of the transition dynamics leading to the Great Recession.

Peculiar to the Great Recession was then the much larger magnitude of shocks rather than their source, and the size of the global real activity contraction, which was (on average per quarter) four times larger than during the previous three episodes. Demand-side and financial shocks account for about two-thirds of the global output contraction during the Great Recession, consistent with the narrative pointing to the real effects of the sub-prime financial crisis working mainly through aggregate demand shortages, due to a credit crunch, an increased level of uncertainty and larger precautionary savings. Coherently, by means of an out-of-sample forecasting exercise, we provide evidence of predictability of the timing of the Great Recession, yet not of its depth.

Our results finally cast some doubts on a purely structural explanation of the 'jobless recovery' phenomenon. In fact, demand-side and financial shocks, in addition to accounting for as much as cyclical employment variance than supply-side disturbances over the whole sample, had an even larger slowing down effect in the year following the end of the Great Recession.

The rest of the article is organized as follows. In Section 2 the econometric methodology is outlined, and details on the identification and economic interpretation of structural shocks are provided. Section 3 presents and discusses results concerning the structural sources of macro-financial fluctuations over the Great Moderation and the transition to the Great Recession. The predictability of the timing and depth of the Great Recession is investigated in Section 4 and conclusions are drawn in Section 5.[1]

II. Econometric methodology

The empirical analysis is cast in terms of a FAVAR econometric model composed of two blocks of equations. The former, the *global-economy* model, describes the dynamics of a broad range of macroeconomic, financial and oil market global factors. The second block, the *local-economies* model, captures the dynamics of the main macroeconomic and financial variables for a large set of developed and emerging economies, and is used to estimate the unobserved global macro-financial factors.

The econometric model

The *global-economy* model contains *unobserved* ($\mathbf{F}_{1,t}$) and *observed* ($\mathbf{F}_{2,t}$) global macro-financial factors and oil market demand and supply side variables ($\mathbf{O}_t$), collected in a $R \times 1$ vector $\mathbf{F}_t = \left[\mathbf{F}_{1,t}^{'}\, \mathbf{F}_{2,t}^{'}\, \mathbf{O}_t^{'}\right]^{'}$. The *local-economies* model refers to Q macro-financial variables for M countries, collected in a $N \times 1$ vector $\mathbf{Z}_t$ (with $N = M \times Q$). The joint dynamics of the *global* and *local* macro-financial blocks are then modelled by means of the following stationary reduced form dynamic factor model

$$(\mathbf{I} - \mathbf{P}(L))(\mathbf{F}_t - \kappa) = \eta_t \tag{1}$$

$$(\mathbf{I} - \mathbf{C}(L))((\mathbf{Z}_t - \mu) - \mathbf{\Lambda}(\mathbf{F}_t - \kappa)) = \mathbf{v}_t, \tag{2}$$

where $(\mathbf{F}_t - \kappa), (\mathbf{Z}_t - \mu) \sim I(0)$, μ and κ are vectors of intercept components of dimension $N \times 1$ and $R \times 1$, respectively, with $R \leq N$, and the contemporaneous effects of the global factors in $\mathbf{F}_t$ on each country's variables in $\mathbf{Z}_t$ are measured by the loading coefficients collected in the $N \times R$ matrix $\mathbf{\Lambda} = \left[\mathbf{\Lambda}_{F_1}^{'}\, \mathbf{\Lambda}_{F_2}^{'}\, \mathbf{\Lambda}_{O}^{'}\right]^{'}$.

[1] A Supplementary Appendix, available online with the working paper version of this article at http://www.carloalberto.org/assets/working-papers/no.424.pdf, provides additional information on the data set, the estimation methods, the identification of structural disturbances and further results.

Global factor dynamics are described by the stationary finite-order polynomial matrix $\mathbf{P}(L)\equiv\mathbf{P}_1L+\mathbf{P}_2L^2+...+\mathbf{P}_pL^p$, where $\mathbf{P}_j$ $(j=1,...p)$ is a square matrix of coefficients of order R, whereas dynamics in the local-economies variables are captured by $\mathbf{C}(L)\equiv\mathbf{C}_1L+\mathbf{C}_2L^2+...+\mathbf{C}_cL^c$, where $\mathbf{C}_j$ $(j=0,..c)$ is a square block (own-country) diagonal matrix of coefficients of order N. Finally, $\eta_t\sim$i.i.d.$(\mathbf{0},\mathbf{\Sigma}_\eta)$ is a $R\times 1$ vector of reduced form global shocks driving the $\mathbf{F}_t$ factors, and $\mathbf{v}_t\sim$ i.i.d.$(\mathbf{0},\mathbf{\Sigma}_v)$ is the $N\times 1$ vector of reduced form country-specific disturbances, with $E\left[\eta_{jt}v_{is}\right]=0$ for all i,j,t,s.

The chosen specification of (1) and (2) embeds important assumptions on the structure of global and local linkages: (*i*) global shocks (η_t) affect both the global and local economies through $\mathbf{P}(L)$ and the factor-loading matrix $\mathbf{\Lambda}$, respectively; (*ii*) country-specific disturbances ($\mathbf{v}_t$) do not affect the global economy, limiting their impact only to the country of origin, due to the assumed block (own-country) diagonal structure for $\mathbf{C}(L)$.

Consistent and asymptotically normal estimates of the coefficients in (1) and (2) are obtained by means of the procedures proposed in Morana (2012, 2014), yielding accurate estimation also in small samples (see the Monte Carlo evidence reported therein). Such procedures involve the iterative estimation of the unobserved factors and the local-economies model, followed by the estimation of the global-economy model conditional on the estimated unobserved factors.

Given the specification of (1) and (2), the disturbances of the global-economy model in η_t have the nature of reduced form innovations. In order to investigate the role of underlying structural shocks in shaping global factor dynamics it is then necessary to adopt an identification scheme. To this aim, we impose a set of exclusion restrictions on the contemporaneous (within quarter) responses of the factors to the structural disturbances, resulting in a precise 'ordering' (discussed below) for the elements of $\mathbf{F}_t$. The structural vector moving average representation for the global model (1) can then be written as

$$(\mathbf{F}_t-\kappa)=\mathbf{H}_F(L)\mathbf{K}^{-1}\xi_t, \tag{3}$$

where $\mathbf{H}_F(L)=[\mathbf{I}-\mathbf{P}(L)]^{-1}$, and $\xi_t=\mathbf{K}\eta_t$ is the vector of the R structural shocks driving the common factors in $\mathbf{F}_t$, with $\mathbf{K}$ being a $R\times R$ invertible matrix. By assumption, the structural factor shocks are orthogonal and have unit variance, so that $E\left[\xi_t\xi_t^{'}\right]=\mathbf{K}\mathbf{\Sigma}_\eta\mathbf{K}^{'}=\mathbf{I}_R$. To achieve exact identification of the structural disturbances, additional $R(R-1)/2$ restrictions are needed. Since $\eta_t=\mathbf{K}^{-1}\xi_t$, imposing exclusion restrictions on the contemporaneous impact matrix amounts to imposing zero restrictions on the elements of $\mathbf{K}^{-1}$, for which a lower triangular structure is assumed. Operationally, $\mathbf{K}^{-1}$ (with the restrictions necessary for exact identification imposed) is estimated by the Choleski decomposition of the factor innovation variance–covariance matrix $\mathbf{\Sigma}_\eta$, that is, $\hat{\mathbf{K}}^{-1}=chol(\hat{\mathbf{\Sigma}}_\eta)$. Forecast error variance and historical decompositions are then derived using standard formulas. Following the thick modelling strategy of Granger and Jeon (2004), median estimates of the parameters of interest, impulse responses, forecast error variance and historical decompositions, as well as their confidence intervals, are obtained by means of simulation.

Specification of the global model

In the current application, the global-economy model (1) counts 33 endogenous variables, collected in vector $\mathbf{F}_t=\left[\mathbf{F}_{1,t}^{'}\,\mathbf{F}_{2,t}^{'}\,\mathbf{O}_t^{'}\right]^{'}$ over the period 1986:1 through 2010:3. $\mathbf{F}_{1,t}$ contains 12 unobserved global factors estimated by means of the local-economies block (2) using a own-country diagonal dynamic structure of the first order, as suggested by the BIC information criterion. The local block counts over 800 equations and contains macroeconomic and financial data for 50 countries.[2] Each unobserved global macro-financial factor is estimated as the first principal component (PC) extracted from a subset of cross-country, homogeneous variables in the local-economies model. In particular, global

[2]The countries are: 31 advanced economies (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, the U.K., the U.S.), 5 advanced emerging economies (Brazil, Hungary, Mexico, Poland, South Africa) and 14 secondary emerging economies (Argentina, Chile, China, Colombia, India, Indonesia, Malaysia, Morocco, Pakistan, Peru, Philippines, Russia, Thailand, Turkey). Main data sources are: International Monetary Fund *International Financial Statistics*, FRED2 (Federal Reserve Bank of St. Louis); OECD and BIS (unofficial) house price data sets and International Energy Agency (IEA-OECD) data sets.

macroeconomic and financial conditions are captured by a *real activity growth* factor (*Y*) extracted from real GDP, private consumption and investment growth series; an *employment growth* factor (*E*) from the civilian employment growth series; an *unemployment rate change* factor (*U*) from changes in the unemployment rate series; a *real wage growth* factor (*W*) from the real wage growth variables; a *fiscal policy stance* factor (*G*), capturing excess public consumption growth, from changes in the ratio of public expenditures to GDP; a global *US$ exchange rate return* index (*X*) obtained from the bilateral exchange rate returns against the US$; a *core inflation* (nominal) factor (*N*) extracted from changes in the series for inflation, nominal money growth rates, short- and long-term interest rates; a global *excess liquidity growth* index (*L*) from changes in the M3 (or M2) to GDP ratio and the private loans to GDP ratio series; a *real stock market return* factor (*F*) from the real stock market price index return series; a *real housing return* factor (*H*) from the real housing price index return series; a *real short-term rate* factor (*SR*) obtained from changes in real short-term interest rates and a *term spread* factor (*TS*) extracted from changes in the term spread series.

$\mathbf{F}_{2,t}$ contains 11 observed factors, added to capture several sources of financial disturbances and fundamental imbalances with potential international spillover effects. Nine factors are the U.S. variables, namely: changes of the *financial fragility* index (*FRA*) used by Bagliano and Morana (2012) and summarizing overall credit conditions, with reference to the corporate, interbank and mortgage markets; the Fama and French (1993) *size* and *value* factors (*SMB, HML*); the Carhart (1997) *momentum* factor (*MOM*); the *stock market liquidity* factor (*PSL*) proposed by Pastor and Stambaugh (2003); the *leverage* factor (*LEV*) constructed by Adrian, Etula and Muir (2014); a *risk aversion* index (*FV*) obtained from a measure of stock return volatility; changes in the ratio of the *U.S. fiscal deficit to GDP* (*Fd*) and in the ratio of the *U.S. trade deficit to GDP* (*Td*). The remaining two observed factors are the returns on the *real gold price* (*GD*) and on the International Monetary Fund *non-energy commodities price index* (*M*). Finally, $\mathbf{O}_t$ contains 10 observed variables concerning global oil market demand and supply conditions, included in order to capture potential effects of oil market developments on global macroeconomic and financial quantities.[3]

Estimation of the global-economy model (1) is then performed by means of the PC-VAR method and involves the first 12 PCs of $\mathbf{F}_t$, jointly accounting for 80% of total variance, and three lags, as suggested by Monte Carlo results (Morana 2012) and specification tests. Hence, 36 parameters are estimated for each of the 33 equations in the model.[4]

Identification of structural disturbances

Structural shocks are identified by means of a Choleski decomposition of the factor innovation variance–covariance matrix. The chosen recursive structure of the global factors in $\mathbf{F}_t$ is motivated by plausible assumptions on their relative speed of adjustment to shocks and theoretical reasoning. Implementation of the recursive identification strategy yields, for each equation in the global-economy model, a series of orthogonalized innovations purged from correlation with all variables placed before in the ordering and interpreted as underlying structural economic disturbances. The selected ordering of the factors in $\mathbf{F}_t$ is as reported below:

- *oil supply conditions*: reserves (*R*), oil production changes (*Pp; Pm*), refineries margins (*RM*);
- *macroeconomic conditions*: employment (*E*), unemployment (*U*), real activity (*Y*), fiscal policy stance (*G*), the U.S. fiscal and trade deficits (*Fd, Td*), core inflation (*N*), real wages (*W*);
- *flow oil demand conditions*: oil consumption (*C*);
- *monetary policy stance* and *interest rates*: excess liquidity (*L*), real short-term rate (*SR*) and term spread (*TS*);
- *financial conditions I*: real housing prices (*H*), US$ exchange rate index (*X*), stock return volatility (*FV*), Fama–French size and value factors

[3]The included variables capture various dimensions of oil market dynamics: (i) global oil supply conditions: *world oil reserves growth* (*R*), positive (*Pp*) and negative (*Pm*) *net world oil production changes*, and *OECD oil refineries margins growth* (*RM*); (ii) flow oil demand conditions: *world oil consumption growth* (*C*); and (iii) oil futures and spot market conditions: *OECD oil inventories growth* (*INV*), *real WTI oil price return* (*OP*), changes in *nominal WTI oil price volatility* (*OV*), the 12-month *futures basis* (*FB*), and the rate of change of the oil futures market *'T' speculation index* (*WT*).

[4]Given the sample size available, the estimation of an unrestricted VAR(3) model would have been unfeasible, counting 99 parameters for each equation.

(*SMB, HML*), Carhart momentum factor (*MOM*), Pastor–Stambaugh stock market liquidity factor (*PSL*), Adrian–Etula–Muir leverage factor (*LEV*);

- *oil futures and spot market conditions*: Working-T index (*WT*), futures market basis (*FB*), oil inventories (*INV*), oil price (*OP*), oil price volatility (*OV*);
- *financial conditions II*: non-energy commodities price index return (*M*), stock market return (*F*), gold price return (*GD*), the U.S. financial fragility index (*FRA*).

Structural innovations are then grouped into two broad classes, 'supply-side' and 'demand-side and financial' disturbances, each including shocks coming from various sources. The main identified sources of supply-side shocks are oil and (non-energy) commodities markets (*OIL*), the labour market (*LM*) and productivity dynamics (*PR*). The identified disturbances coming from the demand-side and the financial sector of the economy concern an aggregate demand (*AD*) shock to the goods market, a saving rate (*SAV*) disturbance, a monetary policy stance (*MP*) shock, a U.S. terms of trade (*TT*) shock, a portfolio allocation (*PA*) disturbance and some risk factor (*RF*) disturbances.

Table 1 lists the various categories of shocks and the corresponding global factor equations from which orthogonalized innovations are obtained. As a general caveat, it should be recalled that the interpretation of the results of the forecast error variance and historical decompositions and the impulse response analysis in terms of structural economic and financial shocks may be sensitive to the chosen ordering of the variables. Since the structural model implied by the recursive identification scheme is exactly identified, the assumed contemporaneous restrictions cannot be tested. However, the reliability of the identifying assumptions is suggested by the results of a joint weak exogeneity test, which, though not providing validation of the set of restrictions at the system level, strongly supports the implied pairwise recursive structure.[5]

III. Evolving macro-financial dynamics since the mid-1980s

On the basis of the adopted identification scheme, the transition from the Great Moderation to the Great Recession is assessed by looking at historical decompositions of several variables in the global-economy model, that allow to disentangle the contributions of the various structural disturbances to the dynamics of global macro-financial factors on a quarter by quarter basis. Cumulative historical decompositions (net of base predictions) are depicted in Figures 1–3 for selected global variables. In all plots, dashed lines portray the behaviour of a

Table 1. Identified structural shocks.

Category of shocks (collective label)	Structural interpretation	Corresponding global factor(s)
Supply-side disturbances		
Oil market (OIL)	Oil supply shocks (OS)	R, Pp, Pm, RM, INV
	Other oil market shocks (OO)	C, WT, FB, OP, OV
Labour market (LM)	Labour supply (LS)	E
	Labour demand (LD)	U
	Unit labour costs (core inflation, CI)	N
Productivity	Productivity shock (PR)	W
Commodities market	Non-energy commodity price shock (PM)	M
Demand-side and financial disturbances		
Goods market	Aggregate demand (AD)	Y
Saving rates (SAV)	Global and U.S. saving rate shocks (GFI, GDI, GTI)	G, Fd, Td
Monetary policy and interest rates (MP)	Excess liquidity, short-term rate and term structure slope shocks (EL, TL, TS)	L, SR, TS
Foreign exchange market	U.S.$ exchange rate shock (terms of trade, TT)	X
Portfolio allocation (PA)	Preference shocks to housing (PH), stocks (PF), gold (PG)	H, F, GD
Risk factors (RF)	Size (SZ), value (VL), momentum (MM), stock market liquidity (SL), leverage (LV), uncertainty (RAV), risk appetite (RAP) shocks	SMB, HML, MOM, PSL, LEV, FV, FRA

In the table, details about the identified structural shocks (central column) and their originating reduced form equations of the global model (right-hand side column) are reported.

[5]The joint weak exogeneity test is based on the Bonferroni bounds principle, and is computed using the 528 possible bivariate tests implied by the recursive structure involving the 33 variables in the global-economy model. The test does not reject, even at the 20% significance level, the weak exogeneity null hypothesis (the value of the test is 0.005 to be compared with a 20% critical value equal to 0.0004).

global factor over the whole 1986–2010 sample, and solid lines show the contribution of each structural shock of interest to global factor dynamics. Shaded areas in the figures correspond to four global recessionary episodes that we identify with protracted declines in the real activity global factor (*Y*, see Figure 1): (*i*) a recession in the early 1990s (from 1990:2 to 1993:2), following the collapse of the high-yield market (1989–1990) and the peak of the savings and loans crisis (1986–1989) in the U.S., the burst of the real estate bubble in Japan (1989–1991), the economic crisis in India (1991), the banking crisis in Finland and Sweden (1991–1993), and the first Persian Gulf War and the ensuing oil price shock (1990); (*ii*) a relatively short downturn in the late 1990s (1997:3–1998:3), associated with the financial crisis in East Asia and Russia (1997–1998); (*iii*) a recessionary period in the early 2000s (2000:4–2003:2), following the burst of the dot-com financial bubble, accounting scandals (2000) and the 11 September terrorist attack (2001) in the U.S., the economic crisis in Argentina (1999–2002) and the second Persian Gulf War (started in 2003) and the related oil price shock; and finally (*iv*) the Great Recession (2008:2–2009:3) ignited by the U.S. subprime financial crisis (2007–2009) and the third oil price shock (2007–2008). Tables 2 and 3 focus on those four episodes, presenting the contributions of various categories of structural disturbances to the overall change of selected global variables in the detected recessionary periods, as well as in the four-quarters following recessions.

Real activity and employment

As shown in Figures 1 and 2, the dynamics of global real activity (*Y*) and employment (*E*) are shaped by shocks from all (supply-side, demand-side and financial) sources over the 1986–2010 sample as a whole. Yet, two sub-periods can be broadly distinguished with somewhat different macro-financial features: the first decade of the sample up to the mid-1990s and the latter part of the period starting thereof.

Wider fluctuations in the contribution of several structural disturbances to global output are detected from the mid-1990s onwards, particularly for productivity (*PR*), goods' aggregate demand (*AD*), global saving rate (*SAV*) shocks (Figure 1, first row) and, to a smaller extent, for shocks to portfolio allocation (*PA*) and to the U.S. terms of trade (*TT*) (Figure 1, second row). On the other hand, a similar contribution to global output dynamics across subsamples is provided by other structural disturbances, such as those originated in the labour market (*LM*, first row) and the risk factor shocks (*RF*, second row). Due to sign compensations, the increased variability of some important sources of shocks did not affect the actual volatility of global output until the recent Great Recession episode and went unnoticed in the literature. In fact, many empirical studies relate the widening in real activity fluctuations to the 2008–2009 recession only (Clark 2009; Canarella et al. 2010; Chen 2011; Stock and Watson 2012; Charles, Darné, and Ferrara 2014; Gadea, Gomez-Loscos, and Pérez-Quiros 2014), whereas our findings point to an increase in volatility of various important sources of disturbances preceding the onset of the Great Recession. Moreover, at a more general level, they also raise the issue of the potential contribution of financial innovation and liberalization to macroeconomic instability, as the widening in real activity fluctuations associated with productivity, portfolio allocation and aggregate demand disturbances might be related to changes in the financial structure of the global economy.[6] They also question somewhat the 'good luck' explanation of the Great Moderation, due to the changing contribution of productivity shocks to output volatility, as well as oil market shocks contributing more to trend than cyclical output dynamics. Global employment fluctuations show a broadly similar, though less clear-cut, pattern across sub-periods (Figure 2), with saving rate shocks and (to a lesser extent) productivity disturbances displaying a larger variability since the mid-1990s, in contrast to risk factor and labour market shocks.

Global recessionary episodes

Focusing on global recessionary periods, several additional features of real activity and employment fluctuations can be noted in Panel A and B of

[6]Gorton and Ordonez (2014) present a model where a credit cycle is initially sustained by a productivity growth revival, subsequently dampened as productivity advances fade away. Indeed, the timing of the 1996–2004 U.S. productivity growth revival (2.9% yearly on average; Gordon 2012) is consistent with a link between productivity dynamics and the ensuing financial crisis.

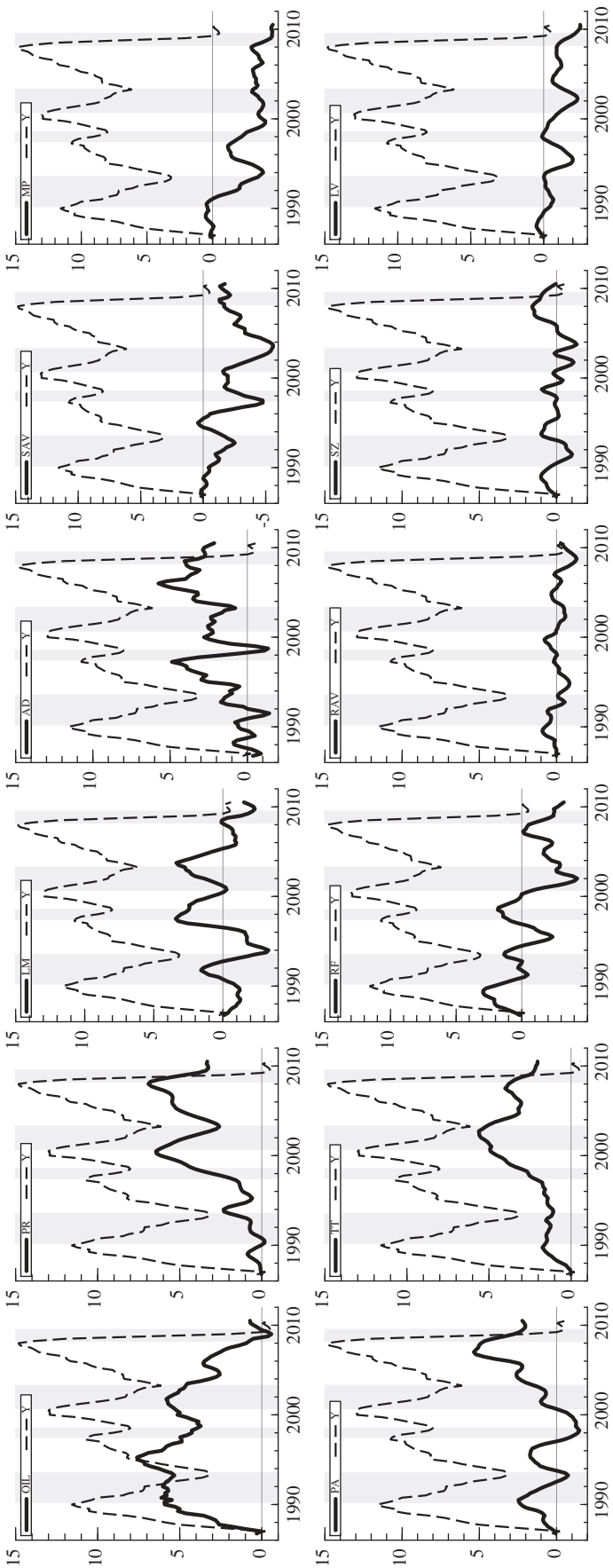

Figure 1. Historical decomposition: real activity; contributions of structural shocks.
The Figure plots the historical decomposition of real activity (Y) relative to the various identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labour market (LM: labour supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate, U.S. saving rate, global ex-U.S. saving rate), monetary policy (MP: excess liquidity, term structure level and slope); U.S. terms of trade (TT); portfolio allocation (PA: stocks, housing and gold preferences); risk factor (RF: size (SZ), value (VL), momentum (MM), stocks' liquidity (SL), leverage (LV), risk aversion (RAV), risk appetite (RAP)).

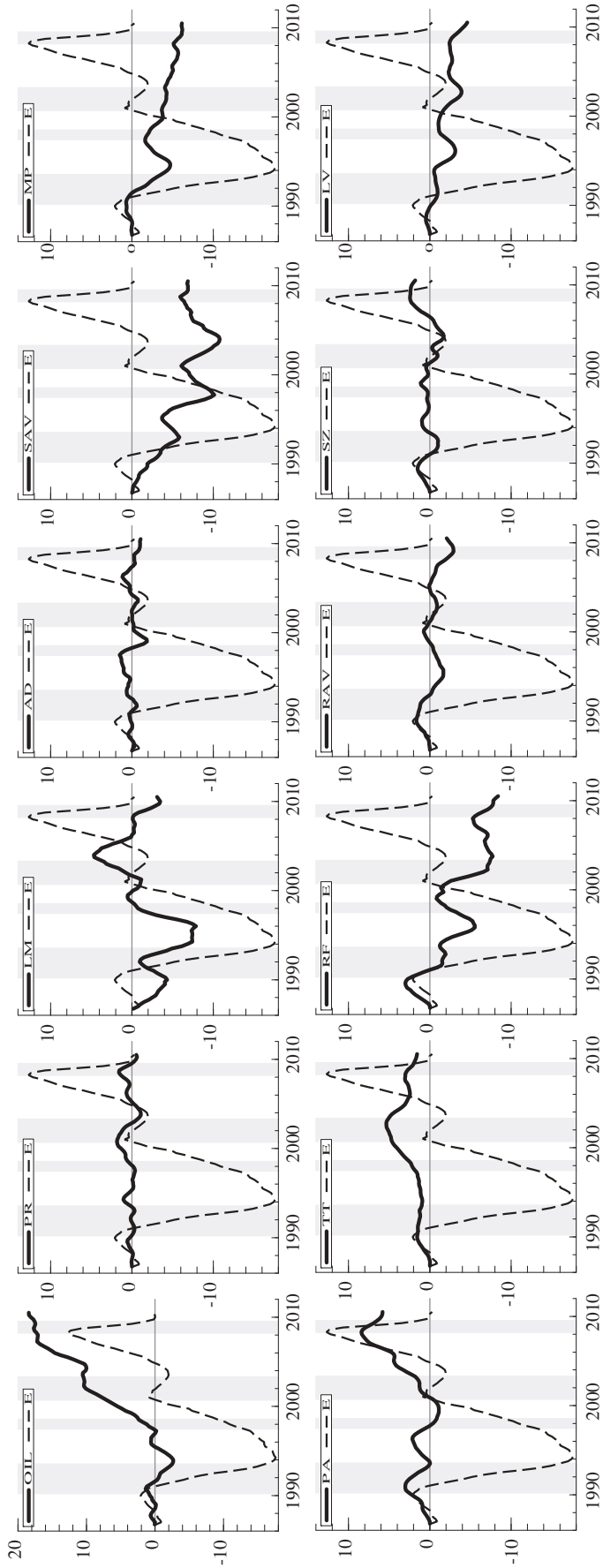

Figure 2. Historical decomposition: employment; contributions of structural shocks.
The Figure plots the historical decomposition of employment (E) relative to the various identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labour market (LM: labour supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate, the U.S. saving rate, global ex-U.S. saving rate), monetary policy (MP: excess liquidity, term structure level and slope); the U.S. terms of trade (TT); portfolio allocation (PA: stocks, housing and gold preferences); risk factor (RF: size (SZ), value (VL), momentum (MM), stocks' liquidity (SL), leverage (LV), risk aversion (RAV), risk appetite (RAP)).

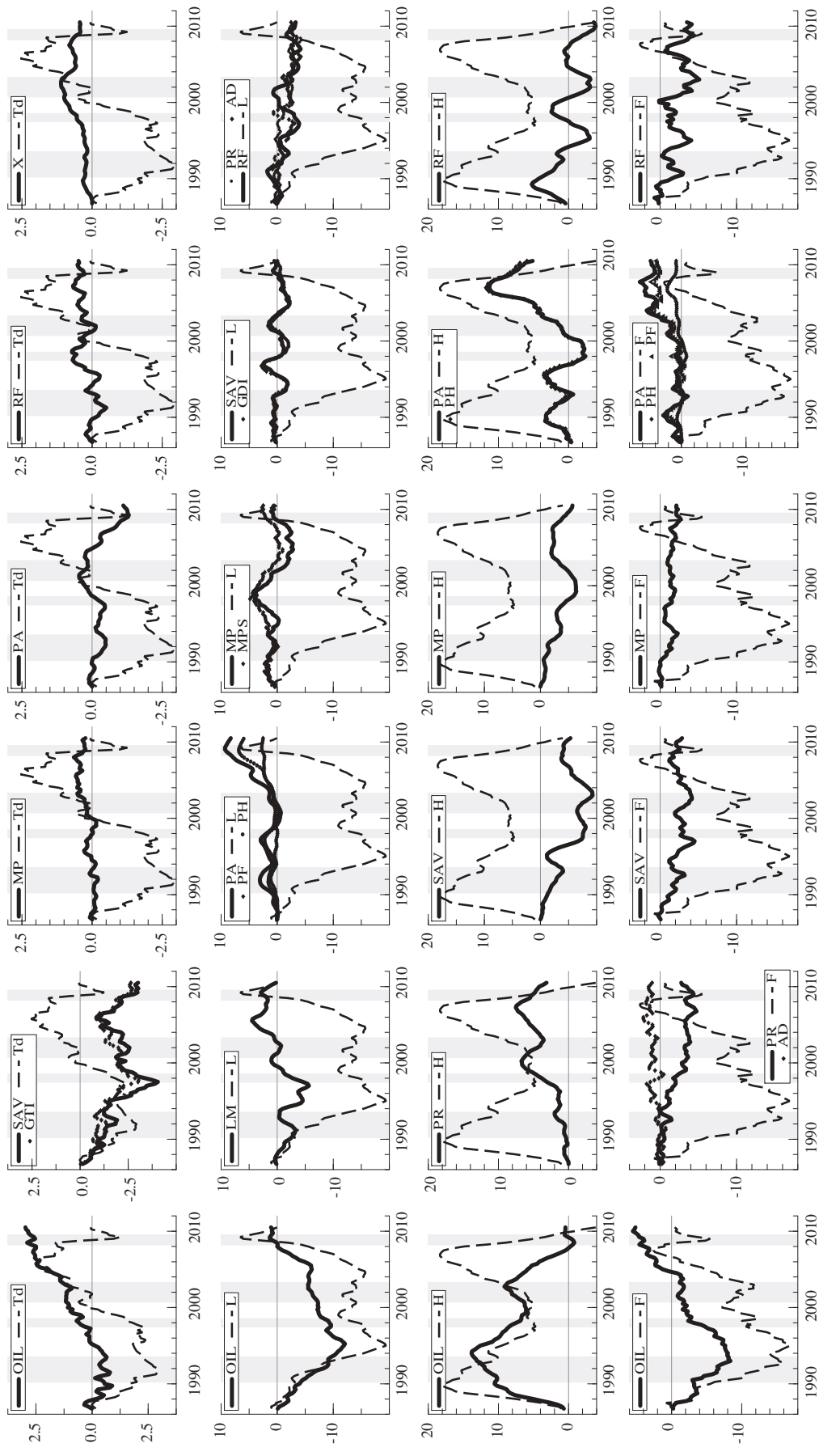

Figure 3. Historical decomposition: the U.S. trade deficit to GDP ratio, excess liquidity, real house price and real stock price factors; contributions of structural shocks.
The Figure plots the historical decomposition of the U.S. Trade deficit to GDP ratio (Td) and the global excess liquidity (L), real house prices (H) and real stock prices (F) factors, relative to selected identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labour market (LM: labour supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate GFI, the U.S. saving rate, global ex-U.S. saving rate GTI), monetary policy (MP: excess liquidity EL, term structure level and slope); the U.S. terms of trade (X); portfolio allocation (PA: stock PF, housing PH and gold preferences); risk factor (RF: size, value, momentum, stocks' liquidity, leverage, uncertainty, risk appetite).

Table 2. Historical decomposition (selected periods): contribution of various categories of shocks to real activity and employment fluctuations.

Panel A: Real activity

	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	Y
90(2)–93(3)	**0.19**	**−0.40**	**1.86**	**−1.26**	**−8.64**	**0.64**	**−1.27**	**−3.83**	**−2.87**	**−0.51**	**−0.79**	**−0.80**	**0.41**	**−0.47**	**−0.14**	**−0.30**	**0.28**	**0.24**	**−8.45**
93(4)–94(3)	1.36	1.79	−0.40	−0.03	1.58	−0.73	1.70	−0.06	1.77	0.30	−1.41	−0.71	−0.11	0.27	−0.04	0.21	−0.93	−0.10	2.95
97(3)–98(3)	**0.96**	**−0.77**	**2.50**	**−0.77**	**−3.72**	**−6.00**	**2.34**	**−1.21**	**−0.85**	**0.99**	**1.01**	**0.01**	**0.67**	**0.07**	**−0.03**	**−0.14**	**0.55**	**−0.12**	**−2.76**
98(4)–99(3)	0.55	−0.06	1.18	−0.57	1.82	2.96	0.43	−1.42	0.23	0.99	−1.38	0.53	−1.07	−0.10	−0.06	−0.38	−0.28	−0.02	2.38
00(4)–03(2)	**−1.53**	**−0.49**	**−3.85**	**2.82**	**−5.35**	**−1.44**	**−3.82**	**0.43**	**1.65**	**0.24**	**−2.42**	**−0.51**	**−0.77**	**0.01**	**−0.44**	**0.03**	**−0.51**	**−0.22**	**−6.88**
03(3)–04(2)	0.87	0.07	−0.32	1.12	−0.36	0.15	−0.50	−0.25	0.33	0.21	−0.28	−0.05	−0.74	0.17	0.07	0.09	0.22	−0.04	0.51
08(2)–09(3)	**−6.04**	**−0.55**	**−3.51**	**−1.98**	**−9.32**	**−1.15**	**−0.33**	**−1.58**	**−2.71**	**−1.56**	**−1.99**	**−0.06**	**−0.71**	**0.43**	**0.02**	**−0.22**	**−1.24**	**−0.20**	**−15.36**
09(4)–10(3)	0.77	0.62	−0.04	0.19	−0.29	−0.29	0.66	0.05	−0.09	−0.19	−0.44	0.47	−0.56	−0.12	0.13	0.13	−0.40	−0.09	0.48

Panel B: Employment

	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	E
90(2)–93(3)	**−4.03**	**−3.23**	**−0.21**	**−0.60**	**−14.03**	**0.54**	**−3.52**	**−4.19**	**−2.27**	**−0.58**	**−4.01**	**−1.98**	**−1.03**	**−0.34**	**−0.18**	**−0.28**	**−0.44**	**0.25**	**−18.07**
93(4)–94(3)	−1.18	0.40	0.89	−2.48	−0.24	−0.35	1.16	−1.16	1.03	0.05	−0.98	−0.87	0.72	0.06	−0.26	−0.03	−0.58	−0.01	−1.42
97(3)–98(3)	**6.01**	**2.57**	**0.76**	**2.68**	**−1.36**	**−2.02**	**−0.26**	**−0.56**	**−1.76**	**0.93**	**2.32**	**0.52**	**0.38**	**0.11**	**0.20**	**0.15**	**1.24**	**−0.29**	**4.65**
98(4)–99(3)	3.13	1.92	0.40	0.82	0.67	−0.70	1.67	−1.24	−0.28	1.05	0.18	0.79	−0.14	0.20	−0.12	−0.52	0.02	−0.05	3.81
00(4)–03(2)	**5.84**	**3.89**	**−2.41**	**4.36**	**−6.68**	**−0.24**	**−3.36**	**−0.32**	**2.45**	**0.55**	**−5.74**	**−1.26**	**−0.88**	**−0.95**	**−0.48**	**0.24**	**−2.10**	**−0.31**	**−0.84**
03(3)–04(2)	0.79	0.26	−0.41	0.95	−1.28	−0.69	−0.52	0.02	0.01	0.26	−0.36	−0.18	−0.32	0.03	−0.09	0.20	0.04	−0.05	−0.48
08(2)–09(3)	**−3.30**	**0.46**	**−0.99**	**−2.77**	**−7.33**	**−0.64**	**−0.38**	**−0.98**	**−1.82**	**−1.06**	**−2.46**	**−1.09**	**0.09**	**0.31**	**0.09**	**−0.47**	**−1.16**	**−0.24**	**−10.63**
09(4)–10(3)	−0.32	0.85	−0.73	−0.44	−1.20	−0.03	0.12	0.05	−0.69	−0.33	−0.33	0.59	−0.32	−0.01	0.26	0.11	−0.82	−0.14	−1.52

In the table, the contributions of various categories of structural disturbances to fluctuations in the global real activity factor Y (Panel A) and the global employment factor E (Panel B) are reported for the four global recessionary episodes occurred in the 1986–2010 period (in bold): The early 1990s recession (1990:2–1993:2); the late 1990s recession (1997:3–1998:3); the early 2000s recession (2000:4–2003:2) and the Great Recession (2008:2–2009:3). The contributions of structural shocks in the four-quarters following recessions are also shown. For each period, the overall actual changes in Y and E are displayed in the last column 'Actual'. The categories of structural disturbances (see Notes to Table 1) are: oil market shocks (OIL), productivity shocks (PR), labour market shocks (LM), goods' aggregate demand shocks (AD), saving rate shocks (SAV), monetary policy stance shocks (MP), portfolio allocation shocks (PA), U.S. terms of trade shocks (TT), overall risk factor shocks (RF). For the latter category of disturbances, the Table shows also the specific contributions of uncertainty shocks (RAV), size factor shocks (SZ), value factor shocks (VL), momentum shocks (MM), stock market liquidity shocks (SL), leverage shocks (LV) and risk appetite shocks (RAP).

Table 3. Historical Decomposition (selected periods): contribution of various categories of shocks to fluctuations in the U.S. trade deficit to GDP ratio, excess liquidity and asset prices.

Panel A: U.S. trade deficit

	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	Td
90(2)–93(3)	**−0.32**	**−0.09**	**−0.01**	**−0.21**	**−0.31**	**0.03**	**−0.28**	**0.06**	**−0.37**	**−0.12**	**0.37**	**0.00**	**0.30**	**−0.04**	**−0.01**	**−0.04**	**0.15**	**0.02**	**−0.63**
93(4)–94(3)	0.65	0.29	0.01	0.34	−0.34	−0.09	−0.35	0.08	0.24	0.08	−0.29	−0.06	−0.20	0.05	0.04	0.01	−0.13	−0.01	0.32
97(3)–98(3)	**−0.01**	**0.53**	**−0.01**	**−0.53**	**0.92**	**−0.62**	**0.99**	**−0.14**	**0.39**	**0.22**	**0.08**	**−0.08**	**0.11**	**0.00**	**−0.02**	**0.05**	**0.00**	**0.02**	**0.91**
98(4)–99(3)	−0.08	0.37	−0.31	−0.14	1.10	0.49	0.78	−0.17	0.22	0.18	−0.41	0.03	−0.30	0.06	−0.02	−0.08	−0.10	−0.01	1.02
00(4)–03(2)	**0.73**	**0.27**	**0.03**	**0.43**	**−0.17**	**−0.11**	**−0.23**	**0.33**	**−0.18**	**−0.01**	**0.03**	**0.06**	**−0.07**	**0.03**	**−0.08**	**−0.05**	**0.16**	**−0.01**	**0.56**
03(3)–04(2)	0.17	−0.06	−0.01	0.24	−0.75	−0.15	−0.44	−0.08	0.07	0.06	−0.21	−0.05	−0.26	0.00	0.00	0.08	0.02	0.00	−0.58
08(2)–09(3)	**−0.24**	**0.24**	**−0.17**	**−0.31**	**−2.05**	**−0.15**	**−0.72**	**−0.37**	**−0.36**	**−0.31**	**−0.14**	**0.15**	**−0.17**	**0.03**	**−0.03**	**0.03**	**−0.15**	**−0.01**	**−2.29**
09(4)–10(3)	0.56	0.20	0.22	0.14	0.23	0.03	0.03	0.07	0.10	−0.01	0.01	0.11	−0.08	−0.08	0.03	0.02	0.01	0.00	0.79

Panel B: Excess liquidity

	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	L
90(2)–93(3)	**−4.96**	**−5.60**	**−1.10**	**1.74**	**−4.53**	**−0.41**	**−1.96**	**−0.29**	**0.87**	**0.23**	**−2.96**	**−0.44**	**−2.03**	**0.13**	**0.04**	**0.23**	**−0.73**	**−0.17**	**−9.49**
93(4)–94(3)	−4.55	−1.73	0.16	−2.98	−0.27	0.51	−0.36	−0.87	−0.46	−0.43	1.34	−0.06	1.38	0.01	−0.35	−0.17	0.32	0.20	−4.82
97(3)–98(3)	**3.51**	**0.64**	**−1.16**	**4.03**	**0.29**	**3.74**	**−3.37**	**1.65**	**−1.91**	**−0.77**	**0.94**	**0.56**	**−0.46**	**−0.03**	**0.33**	**0.01**	**0.58**	**−0.05**	**3.80**
98(4)–99(3)	2.30	1.10	−0.08	1.29	−1.54	−2.76	0.23	−0.55	−0.66	−0.52	2.71	−0.08	1.59	0.54	0.03	0.20	0.49	−0.07	0.76
00(4)–03(2)	**1.93**	**1.64**	**0.76**	**−0.47**	**−1.11**	**1.34**	**1.22**	**−3.51**	**1.57**	**0.34**	**−2.07**	**−0.56**	**0.18**	**−0.93**	**0.41**	**0.20**	**−1.49**	**0.12**	**0.82**
03(3)–04(2)	−0.59	−0.04	0.23	−0.78	−0.09	−0.06	0.06	−0.06	−0.39	0.02	0.33	−0.13	1.07	−0.20	−0.12	−0.05	−0.24	0.01	−0.68
08(2)–09(3)	**3.77**	**1.04**	**1.94**	**0.79**	**6.78**	**0.52**	**0.98**	**2.31**	**1.28**	**1.14**	**0.56**	**−1.19**	**1.13**	**0.05**	**0.31**	**−0.08**	**0.25**	**0.08**	**10.55**
09(4)–10(3)	−2.57	−0.19	−0.77	−1.61	−1.59	0.04	−0.24	0.04	−0.64	−0.16	−0.64	−0.37	0.39	−0.01	−0.14	−0.08	−0.42	−0.02	−4.16

Panel C: House prices

	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	H
90(2)–93(3)	**3.17**	**2.95**	**1.67**	**−1.45**	**−10.79**	**−0.22**	**−2.48**	**−2.69**	**−2.51**	**−0.12**	**−2.77**	**−3.12**	**0.13**	**−0.26**	**−0.17**	**0.35**	**0.10**	**0.21**	**−7.62**
93(4)–94(3)	−0.80	−0.16	−0.81	0.16	1.85	0.43	2.16	−0.37	1.95	0.17	−2.49	−1.47	0.24	−0.12	−0.22	−0.01	−0.88	−0.03	1.04
97(3)–98(3)	**0.44**	**−2.05**	**2.05**	**0.44**	**−0.02**	**0.13**	**−0.51**	**−2.11**	**−0.96**	**1.00**	**2.42**	**1.07**	**0.55**	**0.13**	**0.29**	**−0.53**	**0.99**	**−0.08**	**0.42**
98(4)–99(3)	0.33	−0.62	1.71	−0.76	−0.23	−0.83	0.24	−0.63	−0.13	0.96	0.17	1.02	−0.60	−0.37	−0.21	0.38	−0.08	0.03	0.10
00(4)–03(2)	**1.72**	**2.41**	**−2.83**	**2.14**	**2.79**	**0.76**	**−2.53**	**3.15**	**3.91**	**0.83**	**−3.33**	**−1.41**	**−0.64**	**0.44**	**−0.28**	**−0.18**	**−1.18**	**−0.08**	**4.51**
03(3)–04(2)	0.02	−0.34	0.02	0.34	0.12	0.16	−0.31	0.30	−0.18	0.10	0.05	0.11	0.01	0.11	−0.01	−0.25	0.13	−0.06	0.15
08(2)–09(3)	**−2.83**	**0.81**	**−2.08**	**−1.57**	**−9.83**	**−0.38**	**−0.34**	**−2.08**	**−3.52**	**−0.62**	**−2.90**	**−0.80**	**−0.88**	**0.23**	**−0.02**	**0.07**	**−1.27**	**−0.24**	**−12.66**
09(4)–10(3)	−0.97	−0.09	−1.02	0.14	−3.26	−0.10	−0.76	−0.83	−0.84	−0.46	−0.27	0.99	−0.59	0.05	0.03	0.07	−0.68	−0.14	−4.24

(Continued)

Table 3. (Continued).

Panel D: Stock prices																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	F
90(2)–93(3)	**−5.49**	**−4.89**	**0.49**	**−1.09**	**−3.57**	**−0.24**	**−0.24**	**−2.19**	**−1.60**	**−0.22**	**0.92**	**0.29**	**0.76**	**0.08**	**−0.47**	**−0.19**	**0.30**	**0.13**	**−9.06**
93(4)–94(3)	0.15	0.45	−0.96	0.66	−1.27	0.04	0.28	0.74	−0.12	0.29	−2.50	−0.72	−0.56	0.01	0.29	0.08	−1.53	−0.08	−1.12
97(3)–98(3)	**1.38**	**2.50**	**−0.34**	**−0.78**	**−2.24**	**−2.24**	**1.30**	**−0.94**	**−0.02**	**0.16**	**−0.51**	**−0.01**	**0.74**	**0.00**	**−0.36**	**−0.60**	**−0.15**	**−0.12**	**−0.86**
98(4)–99(3)	−0.08	0.38	−0.73	0.28	2.87	1.88	−0.09	−0.30	0.01	0.05	1.33	1.11	−0.55	0.73	0.00	0.06	−0.12	0.10	2.80
00(4)–03(2)	**1.76**	**0.44**	**−0.35**	**1.68**	**−4.73**	**−0.23**	**−2.01**	**0.26**	**2.06**	**−0.97**	**−3.84**	**−0.45**	**−1.92**	**−0.88**	**−0.29**	**−0.10**	**0.09**	**−0.31**	**−2.97**
03(3)–04(2)	0.05	−0.08	−0.04	0.18	1.06	0.56	0.05	0.02	1.37	−0.17	−0.75	0.00	−0.79	−0.22	0.16	0.04	0.13	−0.07	1.11
08(2)–09(3)	**−0.60**	**0.85**	**−0.52**	**−0.93**	**−2.23**	**−0.43**	**−0.35**	**0.04**	**−1.61**	**0.14**	**−0.03**	**0.00**	**0.05**	**0.41**	**0.26**	**0.21**	**−0.95**	**−0.02**	**−2.83**
09(4)–10(3)	2.10	0.56	1.02	0.52	−1.05	−0.14	−0.47	−0.01	0.42	0.18	−1.02	0.46	−0.82	−0.47	0.02	−0.13	−0.01	−0.06	1.05

Panel E: Non-energy commodity price index																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	M
90(2)–93(3)	**0.37**	**8.73**	**−8.36**	**−10.63**	**−16.40**	**1.49**	**−2.63**	**−8.46**	**−7.10**	**−2.20**	**2.51**	**1.48**	**4.31**	**−3.39**	**−1.37**	**0.35**	**1.18**	**−0.05**	**−16.03**
93(4)–94(3)	0.76	−3.29	4.05	6.25	7.97	−2.67	4.60	3.10	6.56	0.75	−4.37	−0.33	−3.96	2.08	0.83	0.86	−3.44	−0.41	8.73
97(3)–98(3)	**−12.92**	**−7.27**	**−5.65**	**−6.45**	**−9.86**	**−20.83**	**12.95**	**0.79**	**0.49**	**−4.28**	**1.02**	**−0.17**	**3.20**	**0.23**	**−1.07**	**−0.01**	**−1.43**	**0.26**	**−22.78**
98(4)–99(3)	−0.92	1.90	−2.82	−1.18	−8.70	15.37	−6.03	−4.83	0.37	−3.60	−9.99	0.51	−5.95	−4.44	−0.59	1.42	−0.90	−0.05	−9.63
00(4)–03(2)	**−3.16**	**−15.56**	**12.40**	**13.36**	**−3.95**	**−5.90**	**−4.94**	**−7.73**	**3.98**	**5.32**	**5.32**	**2.54**	**−5.54**	**9.51**	**−2.55**	**−0.85**	**2.23**	**−0.02**	**−7.11**
03(3)–04(2)	0.57	−3.08	3.66	4.36	−2.04	1.70	−1.94	−1.75	0.11	3.70	−3.88	−0.21	−4.23	0.38	0.61	−1.05	1.02	−0.40	−1.47
08(2)–09(3)	**−9.78**	**3.09**	**−12.87**	**−7.52**	**−17.81**	**−3.33**	**0.05**	**−2.27**	**−3.73**	**−3.16**	**−5.37**	**1.65**	**−1.56**	**−2.09**	**−0.49**	**0.72**	**−3.36**	**−0.24**	**−27.59**
09(4)–10(3)	8.90	2.41	6.49	1.98	1.62	−1.91	0.12	1.67	2.92	−1.07	−0.12	0.21	−1.89	0.45	0.73	0.14	0.24	0.01	10.51

In the table, the contributions of various categories of structural disturbances to fluctuations in the U.S. trade deficit to GDP ratio (Td, Panel A), in the global excess liquidity factor (L, Panel B), house price factor (H, Panel C), stock price factor (F, Panel D) and in the non-energy commodity price index (M, Panel E) are reported for the four global recessionary episodes occurred in the 1986–2010 period (in bold): The early 1990s recession (1990:2–1993:2); the late 1990s recession (1997:3–1998:3); the early 2000s recession (2000:4–2003:2) and the Great Recession (2008:2–2009:3). The contributions of structural shocks in the four-quarters following recessions are also shown. For each period, the overall actual changes in Td, L, H, F and M are displayed in the last column 'Actual'. The categories of structural disturbances are: oil market shocks (OIL), productivity shocks (PR), labour market shocks (LM), goods' aggregate demand shocks (AD), saving rate shocks (SAV), monetary policy stance shocks (MP), portfolio allocation shocks (PA), U.S. terms of trade shocks (TT), overall risk factor shocks (RF). For the latter category of disturbances, the Table shows also the specific contributions of uncertainty shocks (RAV), size factor shocks (SZ), value factor shocks (VL), momentum shocks (MM), stock market liquidity shocks (SL), leverage shocks (LV) and risk appetite shocks (RAP).

Table 2. Overall, demand-side and financial shocks account for the bulk of output declines during all recessions from the mid-1980s. In the 2000–2003 recession, they determine a drop of −5.3% out of an overall decrease in output of −6.9% (last column of Panel A), and explain −9.3% of the −15.4% output decline during the 2008–2009 Great Recession. A similar observation applies to global employment, for which demand-side and financial shocks account for −14% out of an overall −18% decline in the early 1990s contraction and −7.3% out of −10.6% in the Great Recession period. However, supply-side disturbances become more relevant for global output fluctuations since the late 1990s, explaining −1.5% and −6% of real activity drops in the early 2000s and Great Recession periods, respectively. This result is mostly attributable to a different role played by productivity shocks across recessions, partially dampening the contractionary effects of demand-side disturbances in the two recessions of the 1990s and sizably contributing to deepen the output drop in the 2000s episodes. Oil market shocks provided a relatively limited contribution to all recessions (e.g. explaining only −0.5% of the −15% drop in global output in 2008–2009), but imparted a persistent downward trend in real activity from the mid-1990s (Figure 1, first row).

The identification strategy adopted here allows also to uncover similarities between the recent Great Recession and some of the previous contractionary episodes in terms of their main structural driving forces. In both the 2008–2009 and the early 1990s recessions, shocks originated in the financial sector of the economy played a remarkable role in determining output and employment drops. Portfolio allocation shocks (*PA*) sizably contributed to both recessions, accounting for around −2%/−3% of actual declines in output and employment, whereas disturbances related to the monetary policy stance (*MP*) had a larger impact in the 1990–1993 contraction, when they can explain some −3.8% and −4.2% drops in output and employment, respectively. Conversely, innovations to risk factors (*RF*), signalling changes in investors' expectations and risk attitudes, gave a more substantial contribution in the Great Recession, accounting for −2% of the output and −2.5% of the employment fall. Within the latter category of disturbances, size (*SZ*) and leverage (*LV*) shocks were the most relevant determinants. Overall, those results can be understood by noting that the early 1990s and the 2008–2009 recessions share a broadly similar boom–bust credit cycle origin, rooted in the savings and loans and in the subprime mortgage market crisis, respectively, as well as deep contractions in asset prices (see below). They are also consistent with Stock and Watson (2012), pointing to a more sizable contribution to the depth of the Great Recession by financial disturbances rather than oil market shocks. Our global perspective, however, provides evidence of the relevance of disturbances from a broader range of sources, including productivity, the labour market, portfolio allocation choices and risk factor measures.

Global jobless recoveries

Table 2 also shows the contribution of various structural shocks to global output and employment fluctuations in the first four-quarters of the recoveries following each recession. Several features are worth mentioning. Concerning real activity (Panel A), all recoveries, with the only partial exception of the 1997–1998 episode, are mainly driven by supply-side forces, with demand-side and financial shocks having an offsetting effect in the two most recent recessions, providing a −0.3%/−0.4% contribution to relatively mild output expansions of around 0.5%. Global employment (Panel B) displays reductions not only in the year following the Great Recession (−1.5%) but also during the recoveries occurred after the early 1990s and the early 2000s contractions (amounting to −1.4% and −0.5%, respectively).[7] The latter results are notable since they document that the 'jobless recovery' phenomenon, so far detected for the U.S. economy only (Groshen and Potter 2003; Camacho, Perez-Quiros, and Mendizabal 2011; Kolesnikova and Liu 2011), has an important global dimension, and extends back to (at least) the early 1990s. According to our structural historical decomposition, both supply-side and demand-side/financial driving forces account for the jobless recovery episodes, the latter disturbances showing the larger contribution. In the aftermath

[7]The exception to this pattern is the recovery after the 1997–1998 recession, during which employment rose by 3.8%. However, from the perspective of global employment, the whole late-1990s episode displays peculiar features, since even during the recession period employment actually rose by 4.6% in the face of a contraction of global output of 2.8%.

of the Great Recession, portfolio allocation shocks and, within the risk factor category, innovations to the leverage factor were the most relevant financial structural determinants, whereas among supply-side influences, productivity disturbances (−0.4%) and labour market shocks (−0.7%), sizably contributed to the jobless recovery. Relative to Stock and Watson (2012), who argue that the jobless recovery from the Great Recession in the U.S. was caused mostly by a slowing down in trend labour force growth, our results, based on a finer identification of structural shocks, describe a more composite picture, pointing also to productivity and financial shocks (−1.3%) as significant determinants of the jobless recovery phenomenon.

Global imbalances, liquidity and financial markets

We now turn to a discussion of the main determinants of fluctuations in additional important U.S. and global macroeconomic and financial variables and to the analysis of the developments leading to the onset of the recent financial crisis and Great Recession. Our results point to tight relationships between the buildup of global imbalances, the global monetary policy stance and liquidity conditions and fluctuations in risk factors and asset prices. The overall picture is broadly consistent with the explanation of the deep origins and main mechanisms underlying the recent crisis and ensuing recession provided by Caballero, Farhi and Gourinchas (2008a, 2008b), that we adopt as an organizing framework to discuss our evidence. According to this account, three phases can be distinguished in macro-financial dynamics since the late 1990s. The pre-crisis period is characterized by the building up of global external imbalances and a 'savings glut' phenomenon, with a global excess demand for safe assets, directing capital flows from emerging markets to the U.S. This reallocation of capital flows contributed to maintain low U.S. and world real interest rates, reinforcing the expansionary effects of the Federal Reserve's monetary policy, and fuelled a boom in the U.S. housing and related credit markets, putting pressure on the securitization mechanism, that eventually broke down in early 2007 in the face of falling house prices. The first stage of the crisis, from mid-2007 through mid-2008, is then marked by the freezing of the entire securitization industry, vanishing confidence and pervasive flights to quality, creating even more pressure on the provision of safe financial assets. The ensuing deterioration of balance sheets forced financial institutions into deleveraging and fire sales of assets, transmitting the negative house price shock to the U.S. and world stock markets, that experienced a sharp contraction through early 2009. At the same time, driven by fast growth in emerging economies and portfolio allocation effects, oil as well as other commodity prices rose considerably, even accelerating their pace from mid-2007 to mid-2008. Finally, the second phase of the crisis, from mid-2008 to mid-2009, is characterized by the real effects of the financial turmoil, the bursting of the oil and non-energy commodity price bubbles and the ensuing decline in global real activity. A sequence of asset price misalignments, migrating over time from bond to housing, credit, stock and oil and non-energy commodity markets, is then a distinguishing feature of the 2000s. In what follows, we will focus first on global imbalances and monetary policy conditions, and then on the dynamics of asset prices.

The 'savings glut', the Great Deviation and the Great Leveraging

Several results broadly consistent with the proposed account of the main macro-financial developments leading to the recent financial and economic crisis are delivered by the historical decomposition of key variables, namely the U.S. trade deficit to GDP ratio (*Td*), global excess liquidity (*L*), the leverage factor (*LEV*) and the U.S. exchange rate return index (*X*). The pre-crisis period is indeed characterized by the building up of global external imbalances, as the deterioration in the U.S. current account deficit (shown as the dashed line in Figure 3, first row), while ongoing since 1991, rapidly worsened in 1998 in the aftermath of the East Asia financial crisis, and again in 2000 following the burst of the dot-com bubble. Consistent with the 'savings glut' hypothesis and the pre-crisis scenario envisaged by Caballero, Farhi and Gourinchas (2008b), the worsening in the U.S. trade balance since the late 1990s is largely explained by global non-U.S. saving rate shocks (*GTI*), as well as oil market disturbances (*OIL*), due to the potential impact of oil price dynamics on the U.S. trade balance. Yet, while *OIL* negatively affected trade balance conditions over the whole time span

considered, since 2006 saving rate disturbances actually contributed to its improvement, reflecting a shift away from the U.S. housing market-related securities by international investors. Moreover, both innovations in the global monetary policy stance (*MP*) and risk factor disturbances (*RF*) deepened the U.S. trade imbalance since the early 2000s, while portfolio allocation shifts (*PA*) and terms of trade shocks (*TT*) had a partially offsetting effect. The worsening of *Td* determined by monetary policy shocks accords with the basic mechanism of the international risk-taking channel of monetary policy (Borio and Zhu 2012; Bruno and Shin 2015): over-expansionary U.S. monetary policy caused a contraction in perceived risk and funding costs, fuelling asset prices and the net worth of financial institutions, as well as their leverage and risk-taking attitude, resulting in capital inflows into the U.S. and depreciation of the US$.

The increase in global excess liquidity (*L*) occurred since the mid-1990s (Figure 3, second row, dashed line) is accounted for by shocks originated in the oil and labour markets (*LM*), reflecting the countercyclical use of monetary policy in OECD countries since the 1980s (Sutherland 2010) and in some emerging economies following the sub-prime financial crisis (McGettingan et al. 2013), while shocks to risk factors (*RF*), productivity (*PR*) and goods' aggregate demand (*AD*, shown together in the second row, last plot) have moderated global excess liquidity creation. Feedback effects from asset prices to excess liquidity generation are detected through the contributions of portfolio allocation shocks (mostly due to housing and stock preferences) to global liquidity dynamics, as well as the relevance of leverage-credit spirals unrelated to fundamentals through the contribution of the (own) leverage shock to financial leverage fluctuations. Moreover, the existence of a linkage between global excess demand for safe assets and excess risk-taking by the U.S. financial institutions, and the relevance of a risk-taking channel of monetary policy, are supported by the sizable contribution of global saving rate and monetary policy disturbances to leverage fluctuations. Overall, the above features are consistent with the Great Deviation and Great Leveraging hypotheses, pointing to an empirically relevant relationship between global excess liquidity creation, excessive risk-taking and boom–bust asset price cycles over the time span investigated.

Additional supporting evidence is provided by behaviour of *Td* and *L* during and after recessionary episodes, shown in Table 3. The 'savings glut' hypothesis can explain the worsening of the U.S. trade deficit (Panel A) in the late 1990s and early 2000s recessions (by 0.9% and 0.6%, respectively), with a considerable contribution of global saving shocks (*SAV*) during the former episode (1%). Such disturbances also played a significant role in the Great Recession, contributing by −0.7% to the −2.3% improvement in the U.S. trade deficit, along with other financial shocks, mainly related to the global monetary policy stance and portfolio allocation shifts. Excess liquidity (*L*, Panel B) remarkably increased during the Great Recession (10.6%), largely driven by demand-side (6.8%), and especially global monetary policy disturbances (*MP*, 2.3%), due to widespread generous countercyclical policies. Similarly, *L* increased, though by smaller amounts, in the late 1990s (3.8%) and early 2000s (0.8%) recessions, but in those episodes mostly driven by supply-side shocks. Finally, the deep contraction in the financial leverage factor *LEV* during the Great Recession (−60.4%) is a clear-cut distinguishing feature from previous recessionary episodes, mostly accounted for by financial shocks, particularly risk factor and uncertainty disturbances.

Asset price dynamics

Shocks to global saving rates are also responsible for the downward shift in global real short-term rates from the mid-1990s, as predicted by the 'savings glut' hypothesis, while global monetary policy disturbances contributed to maintain a low interest rate environment. From the early 2000s, also risk factor shocks, related to investors' misperceptions of actual macro-financial risk, contributed importantly to the short-rate downward path. According to the 'migrating bubble' narrative, the excess demand for safe assets, directed to the U.S. bond market since the late 1990s, partially shifted over time to the housing and stock markets and eventually moved to commodity markets. The historical decomposition of global real house (*H*) and stock price (*F*) factors portrayed in Figure 3 (third and last rows) broadly accords with this reading. The house price cycle started in the late 1990s is mostly driven by disturbances to portfolio allocation preferences (*PA*), especially housing preference shocks (*PH*), consistent

with shifts in investors' preferences in favour of the housing market and with a growing fad component in house prices as well. Some of the main driving forces of movements in short rates also sizably affected house prices over both the boom and bust cyclical phases. Shocks to global monetary policy contributed to the surge in *H* up to 2003, as well as to its stabilization until 2008, and decline thereafter. Disturbances to global savings rates and risk factors drove house prices upward since 2003 and then downward since 2007. Moreover, consistent with shifts in investors' preferences in favour of stocks taking place as profit opportunities in the housing market were fading away, *PA* sizably accounts for the rise in stock prices over the 2003–2007 period.

In addition to portfolio allocation shifts, other factors played a role in shaping the stock price cycle. In accordance with the 'savings glut' hypothesis and the evidence for house prices, global saving rate shocks drove *F* upward since the early 2000s, and then downward during the Great Recession; on the other hand, productivity disturbances (*PR*) imparted a downward trend to stock prices over the entire time span. The latter effect, occurred in a period of growing productivity, is broadly consistent with a Shumpeterian view of innovation as a process of creative destruction, as suggested by Kogan et al. (2012), and with the outcome of efficiency gains in production.

Focusing on the Great Recession episode, the contraction in housing prices started in early 2007 led to the break down of the securitization industry. The deterioration of the U.S. financial institutions' balance sheets then forced them into deleveraging and sharp asset sales, transmitting the negative house price shock first to stock markets, and then to commodity markets. A sizable contraction in stock prices occurred from 2007:4 to 2009:1, while non-energy commodity prices declined only over the period 2008:3–2009:1. As the financial crisis turned into an economic crisis, the downturn in global real activity (2008:1–2009:2) drove down the demand for oil and commodities, amplifying the negative financial shock and eventually bursting the oil and commodity price bubbles. Table 3 confirms that the decline in asset prices during the Great Recession was generalized, yet particularly sizable for house (−12.7%, Panel D) and commodity prices (−27.6%, Panel E), and driven by a wide array of macroeconomic (supply-side and demand-side) and financial shocks. Some similarities between the Great Recession and the early 1990s episode can be noted, consistent with their analogous boom–bust credit cycle origin, while asset prices behaviour during the late 1990s and early 2000s episodes are more heterogeneous. The effects of shocks during the Great Recession were however larger than in the early 1990s contraction in the case of house prices (−7.6% in 1990–1993) and commodity prices (−16%), whereas the overall drop in stock prices was more pronounced in the early 1990s recession. Among individual sources of disturbances for asset prices, a significant contribution of global monetary policy and portfolio allocation disturbances to house and commodity price fluctuations is observed in all recessionary episodes.

IV. The end of the Great Moderation?

An important conclusion that can be drawn from our study is that the Great Moderation and the Great Recession were not two unrelated events. In this section we provide further evidence against the 'end of the Great Moderation' view by means of an out-of-sample forecasting exercise. In particular, we show that the Great Recession would have been predictable along the timing, though not the size dimension by conditioning on information already available over the Great Moderation period. This finding is then consistent with the view that the same macroeconomic mechanisms prevailing during the Great Moderation also persisted through the Great Recession, yet with much larger shocks hitting the macroeconomy.

Our forecasting exercise is implemented by recursive estimation of the econometric model in (1–2) and the associated structural innovations. The latter are then employed in various forecasting models, in order to assess the incremental gain in predicting power yielded by their inclusion, relative to past information, on real activity measures for the global economy, the U.S. and the Euro area.

Indeed, the results presented in the previous section point to a remarkable contribution of shocks to a large set of risk factors in shaping fluctuations of global macroeconomic and financial variables over the whole sample. Due to our identification strategy, those disturbances are all orthogonal to past and current changes in global macroeconomic factors,

oil supply, the global monetary policy stance and interest rate movements. Therefore, they are able to capture changes in investors' expectations and risk attitudes in a more complete fashion and are also likely to show 'early warning' or 'forward looking' properties for mounting macro-financial imbalances.

Forecasting models are specified by means of a general-to-specific econometric approach and estimated over the sample 1986:1–2008:1. Out of sample one-step (quarter)-ahead predictions are then generated over the period 2008:2 through 2010:3 *without* updating the model's parameter estimates, which makes our forecasting exercise more challenging. The analysis is carried out in two steps, focusing first on the predictability of the *timing* of the real downturn and the following recovery, and then on the *magnitude* of real activity fluctuations. In the first step, the variable to be predicted is the probability of a recession to occur, simply measured by a dummy variable taking an unitary value during recessions and zero elsewhere. For robustness, predictability is assessed with reference not only to the global output factor (Y) but also to the U.S. and the Euro area output growth rates.[8] Results are presented in Table 4 and Figure 4 (left column). The Table shows, for each real activity measure (Y, *GDPUS* and *GDPEA*), a benchmark autoregressive model (*OD*) and the best performing dynamic models augmented with lagged structural shocks to various risk factors ($OD-X$, $OD-X1$ and $OD-X2$) estimated on 1986:4–2008:1. The one-quarter-ahead out-of-sample predictions are then generated over the period 2008:2–2010:3 and the forecasting performance of the models is assessed. The gain in forecasting power obtained by the augmented models is remarkable irrespective of the metric employed (*RMSE, MAFE* and *TIC*), showing reductions ranging from 50% to 90% of the corresponding forecast error measure for the benchmark autoregressive specification. Indeed, as shown in Figure 4, the improvement in forecasting performance yielded by risk factor innovations stems from their ability to accurately signal the beginning (2008:2 for global output and Euro area GDP growth, and 2008:3 for the U.S. GDP growth) and the end of the economic downturn (especially 2009:4 for global output), as well as the further decline in global real activity occurred at the end of the sample in 2010:3. In contrast, standard dynamic models fail to accurately predict both events.

In the second step we specify forecasting models augmented with structural risk factor innovations directly for the actual rates of change of the global output factor and the U.S. and Euro area GDP. This allows to assess the predictability of the magnitude of real activity fluctuations over the 2008:2–2010:3 period, and of the depth of the Great Recession in particular. As shown in Table 5 and Figure 4 (right column), a 30–60% improvement in forecasting accuracy, depending on metric and target variable, is obtained by means of (asymmetric) augmented models, conditioned on censored (according to sign) risk factor innovations. In particular, a 40–60% contraction in *RMSFE, MAFE* and *TIC* figures is obtained for the U.S. and Euro area GDP growth models, while for global real activity growth the improvement is about 30%.

Overall, two main conclusions can be drawn. First, the timing of economic downturn and recovery following the financial crisis cannot be accurately predicted by standard dynamic models, conditioned on own relevant information only. Predictions are greatly improved when models are augmented with information contained in past risk factor structural innovations. Second, the magnitude of output fluctuations and the depth of the Great Recession cannot be accurately predicted even by the factor innovations-augmented autoregressive models. Both findings are consistent with the in-sample results, showing that the Great Recession was peculiar for its depth, rather than for its mechanics, and therefore predictable along the timing, but not the size dimension. We interpret the latter results as evidence against the 'end of the Great Moderation' view.

V. Conclusions

This article contributes to the literature on the sizable dampening of global macroeconomic fluctuations occurred since the mid-1980s, dubbed the Great Moderation, yielding new insights on its structural features, as well as on the process leading to the Great Recession. Grounded on the view that those

[8]We consider the U.S. economy to be in recession in the 2008:3–2009:2 period. In 2008:2 U.S. output actually increased by an annual rate of 2% over the previous quarter.

Table 4. Out-of-sample forecasting exercise I, 2008:2–2010:3: predicting recession probabilities.

	Global			U.S.				EA		
Y	OD	OD-X	GDPUS	OD	OD-X1	OD-X2	GDPEA	OD	OD-X1	OD-X2
CONST	−0.408	−0.891	**CONST**	−0.800	−1.534	−2.212	**CONST**	−1.320	−1.905	−5.095
	(0.189)	(0.304)		(0.283)	(0.223)	(0.466)		(0.318)	(0.360)	(1.176)
Y(−1)	−1.974	−7.006	**GDPUS(−1)**	−1.277		−3.864	**GDPEA(−1)**	−0.835		
	(0.483)	(1.509)		(0.365)		(1.088)		(0.790)		
SZ(−7)		−2.135	**Y(−1)**		−0.608	−0.677	**Y(−1)**		−0.920	−2.854
		(0.564)			(0.291)	(0.273)			(0.360)	(0.908)
PH(−2)		−1.200	**RAV(−1)**			1.418	**RAV(−6)**			−1.355
		(0.395)				(0.354)				(0.517)
SL(−4)		1.252	**RAP(−4)**			−1.573	**PM(−8)**			1.980
		(0.486)				(0.416)				(0.750)
PF(−2)		1.288	**PF(−3)**			1.486				
		(0.428)				(0.411)				
TS(−3)		−0.978	**MM(−8)**			1.168				
		(0.379)				(0.344)				
AIC	0.743	**0.470**	**AIC**	0.465	0.511	**0.408**	**AIC**	0.409	0.389	**0.276**
BIC	0.801	**0.680**	**BIC**	**0.522**	0.569	0.619	**BIC**	0.469	0.449	**0.397**
HQ	0.766	**0.554**	**HQ**	**0.488**	0.535	0.492	**HQ**	0.433	0.413	**0.324**
RMSE	0.396	**0.151**	**RMSE**	0.326	0.260	**0.154**	**RMSE**	0.490	0.382	**0.061**
MAFE	0.260	**0.061**	**MAE**	0.222	0.179	**0.086**	**MAE**	0.344	0.227	**0.019**
TIC	0.247	**0.092**	**TIC**	0.300	0.228	**0.125**	**TIC**	0.466	0.300	**0.044**

The table reports models for recession probabilities relative to global real activity (Y), the U.S. GDP growth rate (GDPUS) and the Euro area GDP growth rate (GDPEA). The forecasting models are the benchmark own-dynamic autoregressive (OD) and the best performing augmented models (OD-X for global output, OD-X1 and OD-X2 for U.S. and Euro area GDP growth rates), estimated over the period 1986:4–2008:1, with robust coefficient standard errors in brackets. AIC, BIC and HQ are the Akaike, Bayes-Schwarz and Hannan–Quinn information criteria, respectively. One-step ahead out-of-sample forecasts are generated over the period 2008:2–2010:3 and assessed by means of the root mean square forecast error (RMSFE), the mean absolute forecast error (MAFE) and the Theil inequality coefficient (TIC). The lowest values of the information criteria and the forecasting performance statistics are reported in bold. The structural shocks included in the augmented models are the size (SZ), stock market liquidity (SL) and momentum (MM) factor disturbances; the uncertainty (RAV), appetite (RAP) and term structure slope (TS) shocks; the stock (PF) and housing (PH) preference shocks; the non-energy commodities price index (PM) disturbance.

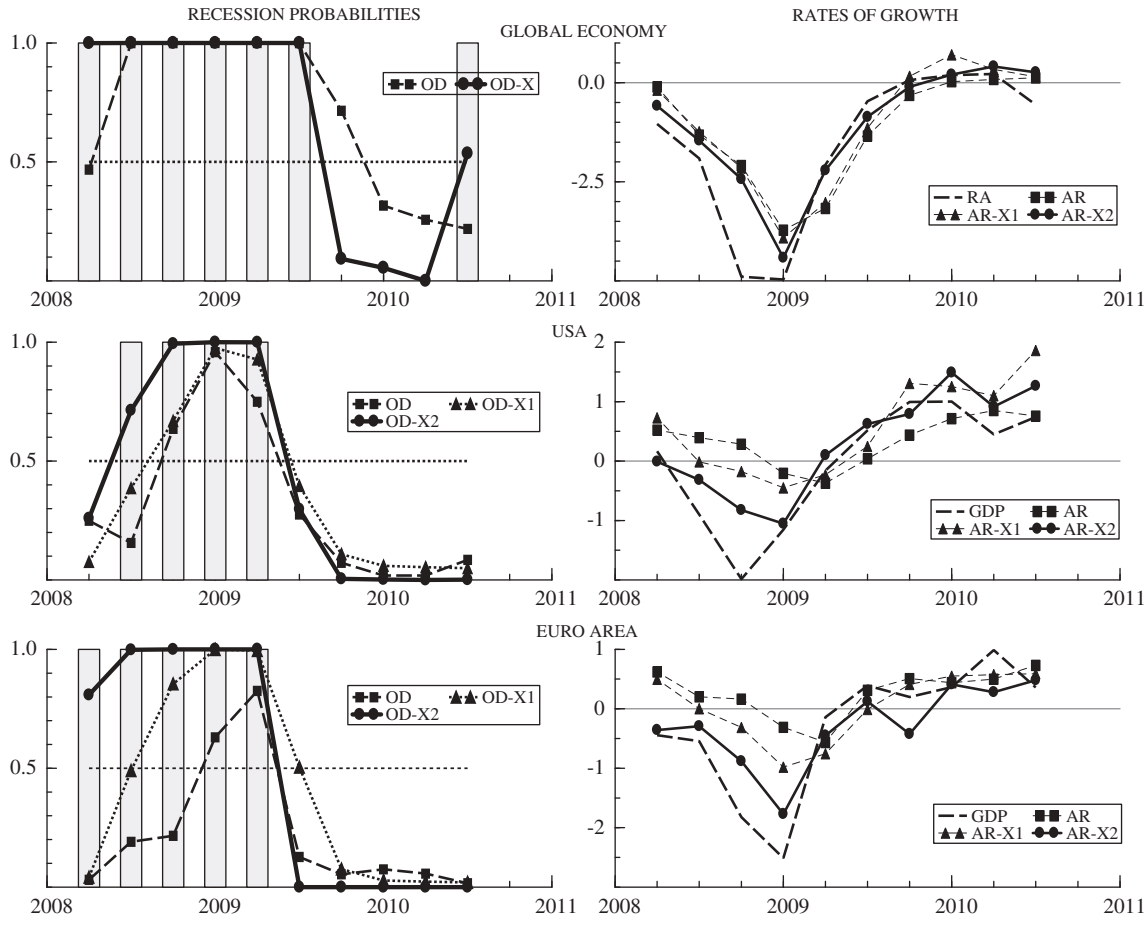

Figure 4. Actual and predicted recession probabilities and real activity/GDP growth.
In the Figure actual and forecast values for recession probabilities (left-hand side plots) and global real activity (Y) and GDP growth rates (right-hand side plots) are plotted over the period 2008:2–2010:3. Top panels report results for the global economy, center panels for the U.S., bottom panels for the Euro area. In the left-hand side plots, actual recession periods are highlighted by shaded bars: 2008:2–2009:3 (and 2010:3) for the global-economy output; 2008:3–2009:2 for the U.S.; 2008:2–2009:2 for the Euro area. The 0.5 probability demarcation value is denoted by the horizontal dotted line. Forecasts generated by the own-dynamics autoregressive model (OD), the own-dynamic autoregressive model augmented by lagged global real activity growth (OD-X1, for the U.S. and the Euro area) and lagged structural innovations (OD-X for global activity, and OD-X2 for the U.S. and the Euro area) are reported using dashed, dotted and solid lines, respectively. Forecasting models are specified as in Tables 4–5. In the right-hand side plots the actual figures are denoted by dashed lines; forecasts generated by the autoregressive model (AR), the autoregressive model augmented by lagged global real activity (AR-X1) and by lagged structural innovations (AR-X2) are denoted by dotted and solid lines. Forecasting models are specified as in Tables 4–5.

phenomena share an important global dimension and are tightly related, we employ a large-scale, global-economy econometric model to identify structural macroeconomic and financial global factors as driving forces of observed fluctuations. A second distinctive feature of our approach is the introduction of a comprehensive array of risk factor indicators in the estimated model. Structural innovations in the latter variables are interpreted as complementary signals of revisions in investors' expectations and risk attitudes, with a potential role as early warning indicators of upcoming real activity downturns.

Our results show that observed macro-financial dynamics over the 1986–2010 period were the outcome of a composite set of disturbances coming from all (demand-side, supply-side and financial) sources, and cannot be associated only with subdued productivity and oil shocks and improved monetary policy management. Moreover, macroeconomic fluctuations do not show the same features over the whole Great Moderation, as heterogeneity in terms of amplitude and determinants are detected, in contrast to the existing literature, well before the onset of the Great Recession. In fact, much wider real fluctuations are detected from the mid-1990s,

Table 5. Out-of-sample forecasting exercise II, 2008:2–2010:3: predicting global real activity and U.S. and Euro area GDP growth.

	GLOBAL					U.S.				EA		
Y	AR	AR-X1	AR-X2	AR-X3	GDPUS	AR	AR-X1	AR-X2	GDPEA	AR	AR-X1	AR-X2
Y(−1)	0.645	0.561	0.524	0.517	**CONST**	0.394	0.567	0.706	**CONST**	0.365	0.542	0.284
	(0.084)	(0.088)	(0.078)	(0.073)		(0.113)	(0.095)	(0.103)		(0.102)	(0.048)	(0.098)
GDPEA(−4)		−0.229			**GDPUS(−1)**	0.173		0.239	**GDPEA(−1)**	0.371		
		(0.104)				(0.108)		(0.080)		(0.155)		
GDPUS(−1)		0.268	0.353	0.385	**GDPUS(−2)**	0.285	0.222		**GDPEA(−3)**			0.340
		(0.087)	(0.088)	(0.090)		(0.108)	(0.110)					(0.076)
SL(p,−4)			−0.208		**Y(−1)**		0.162	0.214	**Y(−1)**		0.264	0.292
			(0.085)				(0.087)	(0.064)			(0.053)	(0.045)
SL(p,−5)				0.220	**Y(−4)**		−0.255	−0.255	**MM(p,−1)**			−0.087
				(0.083)			(0.100)	(0.072)				(0.047)
PF(p,−8)			0.186	0.125	**Y(−5)**		0.201	0.207	**MM(p,−2)**			−0.132
			(0.080)	(0.075)			(0.098)	(0.074)				(0.050)
MM(p,−1)			−0.202	−0.164	**RA(−7)**		−0.232	−0.140	**MM(p,−3)**			−0.126
			(0.077)	(0.072)			(0.077)	(0.057)				(0.050)
RAV(p,−1)			−0.246	−0.251	**SL(n,−7)**			−0.133	**RAP(n,−4)**			−0.114
			(0.097)	(0.088)				(0.060)				(0.047)
RAV(p,−2)			−0.242	−0.226	**LV(n,−5)**			−0.109	**RAP(p,−6)**			−0.133
			(0.092)	(0.086)				(0.065)				(0.053)
EL(n,−8)			0.219	0.152	**RAV(n,−8)**			0.166	**VL(n,-4)**			−0.103
			(0.082)	(0.078)				(0.067)				(0.049)
TL(n,−6)			−0.151	−0.182	**PG(p,−3)**			−0.199	**SL(p,−5)**			0.211
			(0.083)	(0.077)				(0.068)				(0.054)
GFI(n,−1)			−0.219	−0.160	**PG(p,−7)**			−0.353	**RAV(n,−6)**			0.207
			(0.078)	(0.079)				(0.068)				(0.051)
ORP(n,−2)				−0.202	**TL(p,−2)**			−0.204	**RAV(p,−1)**			−0.229
				(0.078)				(0.077)				(0.058)
ORP(p,−1)				−0.179	**PM(n,−3)**			0.174	**TL(n,−6)**			−0.104
				(0.088)				(0.063)				(0.052)
ORP(p,−5)				−0.244	**GDI(n,−7)**			−0.122	**TL(n,−7)**			−0.242
				(0.083)				(0.063)				(0.057)
ORP(p,−6)				−0.247	**TT(n,−3)**			−0.252	**PH(n,−8)**			−0.114
				(0.088)				(0.070)				(0.065)
									GFI(n,−1)			−0.203
												(0.051)
R2	0.376	0.479	0.660	**0.741**	**R2**	0.130	0.278	**0.701**	**R2**	0.138	0.188	**0.719**
R2c	0.376	0.466	0.615	**0.688**	**R2c**	0.109	0.230	**0.635**	**R2c**	0.138	0.178	**0.652**
AIC	1.781	1.547	1.264	**1.096**	**AIC**	1.428	1.325	**0.688**	**AIC**	1.134	1.074	**0.222**
BIC	1.810	1.635	1.566	**1.519**	**BIC**	1.514	1.505	**1.141**	**BIC**	1.191	1.132	**0.705**
HQ	1.793	1.582	1.385	**1.265**	**HQ**	1.462	1.397	**0.870**	**HQ**	1.157	1.097	**0.415**
RMSE	1.152	1.093	0.877	**0.788**	**RMSE**	0.931	0.824	**0.508**	**RMSE**	1.055	0.815	**0.508**
MAFE	0.892	0.838	0.564	**0.528**	**MAE**	0.682	0.663	**0.407**	**MAE**	0.774	0.659	**0.410**
TIC	0.274	0.259	0.206	**0.185**	**TIC**	0.632	0.434	**0.278**	**TIC**	0.683	0.501	**0.285**

The table reports the autoregressive (AR) and the best performing augmented autoregressive (AR-X1, AR-X2 and AR-X3) models, estimated over the period 1986:4–2008:1, with robust coefficient standard errors in brackets. AIC, BIC and HQ are the Akaike, Bayes-Schwarz and Hannan–Quinn information criteria, respectively. One-step ahead out-of-sample forecasts are generated over the period 2008:2–2010:3 and assessed by means of the root mean square forecast error (RMSFE), mean absolute forecast error (MAFE) and the Theil inequality coefficient (TIC). The lowest values of the information criteria and the forecasting performance statistics are reported in bold. The predicted variables are global real output growth (Y) and U.S. and EA real GDP growth (GDPUS and GDPEA). The lagged censored (positive (p), negative (n)) structural shocks included in the augmented models are the size (SZ), value (VL), stock market liquidity (SL), momentum (MM) and leverage (LV) factor disturbances; the uncertainty (RAV) and appetite (RAP) shocks; the excess liquidity (EL) and term structure level (TL) disturbances; the global (GFI) and U.S. (GDI) saving rate shocks; the stock (PF), housing (PH) and gold (PG) preference shocks; the other oil price (ORP) and non-energy commodities price (PM) disturbances.

determined by productivity, goods' aggregate demand and global saving rate shocks, as well as portfolio allocation and the U.S. terms of trade disturbances. In this perspective, the late 2000s financial crisis and economic contraction were the eventual outcome of an already ongoing process, determined by both macroeconomic and financial disturbances, broadly consistent with the account provided by Caballero, Farhi and Gourinchas (2008b).

Our findings also point to the 'savings glut' view of the buildup of global imbalances (Bernanke 2005), the 'Great Deviation' hypothesis on the global monetary policy stance (Taylor 2013) and the 'Great Leveraging' view about financial intermediaries' risk-taking behaviour (Taylor 2012) as complementary explanations of the transition dynamics leading to the Great Recession. Misalignments in asset prices also appear to have migrated from bond to housing and credit markets since the early 2000s, and then to stock and commodity markets following the contraction in house prices since 2007.

Peculiar to the Great Recession was the much larger magnitude of shocks rather than their source, and the size of the global real activity contraction, which was (on average per quarter) four times larger than during the previous three episodes. Demand-side and financial shocks account for about two-thirds of the −15% drop in global output over the 2008:2–2009:3 period, with disturbances to portfolio allocation and innovations to risk factors playing a substantial role. The overall evidence is then consistent with the narrative pointing to the real effects of the sub-prime financial crisis working mainly through aggregate demand shortages, due to a credit crunch, an increased level of uncertainty and larger precautionary savings.

Our results also points to similarities between recoveries following recessionary episodes. In particular, we find that the 'jobless recovery' phenomenon is not limited to the aftermath of the Great Recession but extends back to at least the early 1990s recession and displays an important global dimension, previously unnoticed in the literature. In this respect, our findings cast some doubts on a purely structural explanation of this phenomenon. In fact, demand-side and financial shocks (particularly portfolio allocation, terms of trade and risk factor), in addition to accounting for as much as cyclical employment variance than supply-side (productivity and labour market) disturbances over the whole sample, had an even larger slowing down effect in the year following the end of the Great Recession.

Finally, by means of an out-of-sample forecasting exercise we provide evidence against the 'end of the Great Moderation' view. In fact, we find that dynamic models augmented with lagged risk factor innovations could have accurately predicted the timing of the cyclical downturn and upturn in the global-economy output factor and in the U.S. and Euro area GDP growth. Yet, the magnitude of output fluctuations and the depth of the Great Recession cannot be accurately predicted even by the factor innovations-augmented autoregressive models. Both findings are consistent with the in-sample results, showing that the Great Recession was peculiar for its depth, due to the size of the shocks, but featured the same macroeconomic mechanisms at work also during the Great Moderation period.

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